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181 [Using a human face in an interface](#)

Janet H. Walker, Lee Sproull, R. Subramani

 April 1994 **Proceedings of the SIGCHI conference on Human factors in computing systems: celebrating interdependence**

 Full text available: pdf(814.24 KB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: anthropomorphism, facial animation, facial expression, multimodal interfaces, personable computers, user interface design

182 [Dissertation Abstracts in Computer Graphics](#)

Clifford A. Shaffer

 September 1993 **ACM SIGGRAPH Computer Graphics**, Volume 27 Issue 2

 Full text available: pdf(1.47 MB) Additional Information: [full citation](#)

183 [Communicative facial displays as a new conversational modality](#)

Akikazu Takeuchi, Katashi Nagao

 May 1993 **Proceedings of the SIGCHI conference on Human factors in computing systems**

 Full text available: pdf(1.03 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The human face is an independent communication channel that conveys emotional and conversational signals encoded as facial displays. Facial displays can be viewed as communicative signals that help coordinate conversation. We are attempting to introduce facial displays into computer-human interaction as a new modality. This will make the interaction tighter and more efficient while lessening the cognitive load. As the first step, a speech dialogue system was selected to investigate the power ...

Keywords: anthropomorphism, conversational interfaces, facial expression, multimodal interfaces, user interface design

184 [The society of objects](#)

Mario Tokoro


 April 1993 **ACM SIGPLAN OOPS Messenger**, Addendum to the proceedings on Object-oriented programming systems, languages, and applications (Addendum), Volume 5 Issue 2

Full text available:  [pdf\(1.47 MB\)](#)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)**185** Pump it up: computer animation of a biomechanically based model of muscle using the finite element method

David T. Chen, David Zeltzer

July 1992 **ACM SIGGRAPH Computer Graphics , Proceedings of the 19th annual conference on Computer graphics and interactive techniques**, Volume 26 Issue 2Full text available:  [pdf\(6.73 MB\)](#)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)**Keywords:** character animation, finite element method, non-linear dynamics**186** Interactive graphics for plastic surgery: a task-level analysis and implementation

Steven Pieper, Joseph Rosen, David Zeltzer

June 1992 **Proceedings of the 1992 symposium on Interactive 3D graphics**Full text available:  [pdf\(1.25 MB\)](#)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)**187** Modeling and analysis of empirical data in collaborative environments

Ingrid Carlbom, William M. Hsu, Gudrun Klinker, Richard Szeliski, Keith Waters, Michael Doyle, Jim Gettys, Kristen M. Harris, Thomas M. Levergood, Ricky Palmer, Larry Palmer, Marc Picart, Demetri Terzopoulos, David Tonnesen, Michael Vannier, Greg Wallace

June 1992 **Communications of the ACM**, Volume 35 Issue 6Full text available:  [pdf\(7.02 MB\)](#)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#), [review](#)**Keywords:** facial animation, medical and biological imaging, octrees**188** Multi-modal natural dialogue

Kristinn R. Thorisson, David B. Koons, Richard A. Bolt

June 1992 **Proceedings of the SIGCHI conference on Human factors in computing systems**Full text available:  [pdf\(191.20 KB\)](#)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)**189** Performance-driven facial animation

Lance Williams

September 1990 **ACM SIGGRAPH Computer Graphics , Proceedings of the 17th annual conference on Computer graphics and interactive techniques**, Volume 24 Issue 4Full text available:  [pdf\(7.06 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

As computer graphics technique rises to the challenge of rendering lifelike performers, more lifelike performance is required. The techniques used to animate robots, arthropods, and suits of armor, have been extended to flexible surfaces of fur and flesh. Physical models of muscle and skin have been devised. But more complex databases and sophisticated physical modeling do not directly address the performance problem. The gestures and expressions of a human actor are not the solution to a dynam...

190 Personal computing

Larry Press

March 1990 **Communications of the ACM**, Volume 33 Issue 3Full text available:  [pdf\(949.71 KB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)**191** Layered construction for deformable animated characters


J. E. Chadwick, D. R. Haumann, R. E. Parent

July 1989 **ACM SIGGRAPH Computer Graphics , Proceedings of the 16th annual conference on Computer graphics and interactive techniques**, Volume 23 Issue 3Full text available:  [pdf\(2.49 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

A methodology is proposed for creating and animating computer generated characters which combines recent research advances in robotics, physically based modeling and geometric modeling. The control points of geometric modeling deformations are constrained by an underlying articulated robotics skeleton. These deformations are tailored by the animator and act as a muscle layer to provide automatic squash and stretch behavior of the surface geometry. A hierarchy of composite deformations provides t ...

192 Physically-based modeling: past, present, and future

D. Terzopoulos, J. Platt, A. Barr, D. Zeltzer, A. Witkin, J. Blinn


July 1989 **ACM SIGGRAPH Computer Graphics , ACM SIGGRAPH 89 Panel Proceedings**, Volume 23 Issue 5Full text available:  [pdf\(3.65 MB\)](#) Additional Information: [full citation](#), [abstract](#), [index terms](#)

My name is Demetri Terzopoulos and my co-chair, John Platt, and I would like to welcome you to the panel on Physically-Based Modeling -- Past, Present and Future. I'll start by introducing the panelists; the affiliations you see listed on the screen are somewhat out of date.

I'm Program Leader of modeling and simulation at the Schlumberger Laboratory for Computer Science in Austin, Texas, and I was formerly at Schlumberger Palo Alto Research. I'll speak on the subject of def ...

193 The motion dynamics of snakes and worms

Gavin S. P. Miller

June 1988 **ACM SIGGRAPH Computer Graphics , Proceedings of the 15th annual conference on Computer graphics and interactive techniques**, Volume 22 Issue 4Full text available:  [pdf\(6.78 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Legless figures such as snakes and worms are modelled as mass-spring systems. Muscle contractions are simulated by animating the spring tensions. Directional friction due to the surface structure is included in the dynamic model and legless figure locomotion results. Various modes of locomotion are described.

Keywords: animation, deformation, dynamics, elasticity, locomotion, modeling, rendering, simulation, texture

194 Principles of traditional animation applied to 3D computer animation

John Lasseter

August 1987 **ACM SIGGRAPH Computer Graphics , Proceedings of the 14th annual conference on Computer graphics and interactive techniques**, Volume 21 Issue 4Full text available:  [pdf\(1.21 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)


This paper describes the basic principles of traditional 2D hand drawn animation and their

application to 3D computer animation. After describing how these principles evolved, the individual principles are detailed, addressing their meanings in 2D hand drawn animation and their application to 3D computer animation. This should demonstrate the importance of these principles to quality 3D computer animation.

195 A muscle model for animation three-dimensional facial expression

Keith Waters

August 1987 **ACM SIGGRAPH Computer Graphics , Proceedings of the 14th annual conference on Computer graphics and interactive techniques**, Volume 21 Issue 4


Full text available:  [pdf\(995.74 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The development of a parameterized facial muscle process, that incorporates the use of a model to create realistic facial animation is described. Existing methods of facial parameterization have the inherent problem of hard-wiring performable actions. The development of a muscle process that is controllable by a limited number of parameters and is non-specific to facial topology allows a richer vocabulary and a more general approach to the modelling of the primary facial expressions. A brief discussion ...

196 Real-time manipulation of texture-mapped surfaces

Masaaki Oka, Kyoya Tsutsui, Akio Ohba, Yoshitaka Kurauchi, Takashi Tago

August 1987 **ACM SIGGRAPH Computer Graphics , Proceedings of the 14th annual conference on Computer graphics and interactive techniques**, Volume 21 Issue 4


Full text available:  [pdf\(2.18 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

A system for real-time texture mapping was constructed. Here, "real-time" means that the system reacts to changes in parameter values which define the shape of surfaces and the viewing point that are given by its operator 30 times per second. This real-time processing enables interactive manipulation of texture-mapped free-form surfaces and various application software has been developed taking advantage of this ability. The system owes its performance to a new algorithm for texture mapping which ...

197 Automated lip-synch and speech synthesis for character animation

J. P. Lewis, F. I. Parke

May 1986 **ACM SIGCHI Bulletin , Proceedings of the SIGCHI/GI conference on Human factors in computing systems and graphics interface**, Volume 17 Issue SI

Full text available:  [pdf\(757.78 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

An automated method of synchronizing facial animation to recorded speech is described. In this method, a common speech synthesis method (linear prediction) is adapted to provide simple and accurate phoneme recognition. The recognized phonemes are then associated with mouth positions to provide keyframes for computer animation of speech using a parametric model of the human face. The linear prediction software, once implemented, can also be used for speech resynthesis. The synthesis ...

198 Computer graphic modeling of american sign language

Jeffrey Loomis, Howard Polzner, Ursula Bellugi, Alyn Blakemore, John Hollerbach

July 1983 **ACM SIGGRAPH Computer Graphics , Proceedings of the 10th annual conference on Computer graphics and interactive techniques**, Volume 17 Issue 3

Full text available:  [pdf\(842.33 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The essential grammatical information of American Sign Language (ASL) is conveyed through changes in the movement and spatial contouring of the hands and arms. An interactive computer graphic system is described for the analysis and modeling of sign language movement. This system consists of four components. The first component reconstructs actual movements in three dimensions and allows the user to interactively

segment and transform the data for later analysis. The second component allows ...

Keywords: American sign language, Movement

199 Animating facial expressions

Stephen M. Platt, Norman I. Badler

August 1981 **ACM SIGGRAPH Computer Graphics , Proceedings of the 8th annual conference on Computer graphics and interactive techniques**, Volume 15
Issue 3

Full text available:  [pdf\(705.33 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Recognition and simulation of actions performable on rigidly-jointed actors such as human bodies have been the subject of our research for some time. One part of an ongoing effort towards a total human movement simulator is to develop a system to perform the actions of American Sign Language (ASL). However, one of the "channels" of ASL communication, the face, presents problems which are not well handled by a rigid model. An integrated system for an internal represent ...

200 SIGGRAPH 1 - Computer graphics: Computer generated animation of faces

Frederick I. Parke

August 1972 **Proceedings of the ACM annual conference - Volume 1**

Full text available:  [pdf\(1.02 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

This paper describes the representation, animation and data collection techniques that have been used to produce "realistic" computer generated half-tone animated sequences of a human face changing expression. It was determined that approximating the surface of a face with a polygonal skin containing approximately 250 polygons defined by about 400 vertices is sufficient to achieve a realistic face. Animation was accomplished using a cosine interpolation scheme to fill in the intermediate frames ...

Keywords: computer animation, computer graphics, cosine interpolation, facial topology, flexible surfaces, half-tone rendering, polygonal surfaces, smooth shading, three-dimensional data acquisition

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